REMARKS

Claims 10-15 are pending in the present application.

Claim Rejections-35 U.S.C. 112

Claims 10-15 have been rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The Examiner has alleged that the features of claim 10 including "the etching mask having an opening over the conductive member and the opening being misaligned to include an offset portion extending beyond the conductive member" is new matter. Applicant respectfully disagrees for the following reasons.

As described beginning on page 7, line 23 of the application, before the etching process begins, a resist mask 26 made of a photoresist material is formed on the surface 23a of the structure by photolithography, as illustrated in Fig. 1(b). The opening 26a is formed with a diameter D1 which substantially corresponds to the width of the electrode member 24. As further described beginning on page 8, line 12 of the present application, when the opening 26a of resist mask 26 is formed at a position where the opening 26a is aligned with electrode member 24, an offset of opening 26a with respect to electrode member 24 as shown in Fig. 1(b) does not occur. The electrode member 24 serves as an etching stopper, so that the etched hole is formed to open in correct alignment with electrode member 24.

As further described beginning on page 8, line 19 of the present application, if

the etching process conditions are such that an offset s caused by misalignment of resist mask 26 occurs, offset s of the etched hole 27 is likely to extend below electrode member 24 and reach lower electrode member 25, as may be understood in view of Figs. 1(b) and 1(c). This offset is indicated in Fig. 1(b) as the rightward portion of opening 26a which is bounded by the inwardly pointing arrows, and which extends in a vertical direction beyond the edge or perimeter of electrode member 24.

Accordingly, Applicant respectfully submits that the above noted features of claim 10 may be interpreted as illustrated and described with respect to Fig. 1(b) of the present application as noted above, and that these features of claim 10 are not new matter. Claims 10-15 are thus in compliance with the written description requirement under 35 U.S.C. 112, first paragraph. The Examiner is therefore respectfully requested to withdraw this rejection for at least these reasons. **If this rejection is to be maintained, the Examiner is respectfully requested to clearly establish on the record why the above noted features of claim 10 are considered new matter, particularly in view of Fig. 1(b) of the present application.**

Claims 10-15 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite. This rejection is respectfully traversed for the following reasons.

Although not necessarily limited thereto, the offset portion of the etching mask opening in claim 10 may be interpreted as corresponding to the rightward portion of opening 26a as bounded by the inwardly pointing arrows in Fig. 1(b) of the present application. Accordingly, Applicant respectfully submits that claims 10-15 are in

compliance with 35 U.S.C. 112, second paragraph, and thus respectfully urges the Examiner to withdraw this rejection for at least these reasons.

Claim Rejections-35 U.S.C. 103

Claims 10-15 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the Tahara et al. reference (U.S. Patent No. 5,356,515), in view of the Yamada reference (U.S. Patent No. 5,827,778) and the Pu et al. reference (U.S. Patent No. 5,843,847). This rejection is respectfully traversed for the following reasons.

As described generally on page 9, lines 1-9 of the present application, in the etching process of the invention, the reaction by an etching gas includes an etching action, and a polymerizing action that deposits a polymeric product on the etched portion. The etching gas and conditions are intentionally set in the present invention so that the polymeric product is deposited in the etched groove of Fig. 1(c) which is formed due to mask misalignment. The polymeric product as intentionally deposited in the groove during the etching process acts as an etch stop, so that etching of the groove does not continue all the way through to lower electrode 25, to thereby cause a short circuit upon subsequent filling of the etched hole with conductive material 32 shown in Fig. 1(d). Accordingly, in the present invention, the polymeric product is intentionally deposited within the misalignment groove and is used as an etch stop to stop etching of the misalignment groove.

The method of forming a conductive path in a semiconductor device of claim 10

includes in combination "etching a hole in the insulating layer to the conductive member using the etching mask and a reactive gas, the hole including a misalignment groove in the insulating layer at a side of the conductive member that corresponds to the offset portion of the opening in the etching mask" and "stopping a downward extension of said etching of the misalignment groove by using a polymeric product as an etch stop, the polymeric product generated by a polymeric film generating action of the reactive gas during said etching". Applicant respectfully submits that the method of forming a conductive path of claim 10 would not have been obvious in view of the prior art as relied upon by the Examiner.

In the Tahara et al. reference as primarily relied upon by the Examiner, contact hole 87 is shown in Fig. 7B as formed through silicon dioxide layer 82 to poly-Si wiring 85. Contact hole 87 is shown as aligned with wiring 85, so that a misalignment groove is not formed extending downward through silicon dioxide layer 82 along a perimeter of wiring 85. The occurrence of misalignment grooves is not described or even remotely considered in the Tahara et al. reference. That is, the Tahara et al. reference is generally directed to increasing etching rate and selectivity. Since misalignment grooves are not disclosed or even remotely considered, the Tahara et al. reference clearly fails to disclose or even remotely suggest the need or use of a polymeric product as an etch stop in order to stop etching of a misalignment groove, as featured in claim 10.

In the Yamada reference as secondarily relied upon by the Examiner, an object

is to prevent and/or solve the problem of mask misalignment, whereby a via-hole may protrude beyond a side of an interconnect, as shown in Fig. 1C. As described beginning in column 2, line 1 of the Yamada reference with respect to Figs. 2A and 2B, a conventional approach uses a reduced time interval for over-etching. A still further conventional approach as described beginning in column 2, line 12 with respect to Figs. 3A-3E of the Yamada reference is to employ a laminated structure, whereby first interlayer insulating film 75 prevents etching from proceeding to the lateral side of first interconnect 74, as particularly illustrated in Fig. 3D. An additional conventional example is described beginning in column 3, line 32 of the Yamada reference with respect to Figs. 4A-4D, wherein however formation of the misalignment groove to substrate 81 is evident without remedy. **<u>Accordingly, the conventional prior art processing methods as described in the Yamada reference are not disclosed or remotely suggested as using a polymeric product formed during etching of a misalignment groove as an etch stop, as featured in claim 10.</u>**

In a preferred embodiment as described with respect to Figs. 5A-5F of the Yamada reference, etching is stopped by first interlayer insulating film 14 as described in column 7, lines 27-40, so that a misalignment groove is not formed. In a preferred embodiment as described with respect to Fig. 7A-7B of the Yamada reference, the misalignment groove is similarly prevented from occurring by use of silicon oxide film 14. In a third preferred embodiment of the Yamada reference as particularly described in column 9, lines 55-59 with respect to Fig. 8C, the etching condition is controlled to

increase flourine content, so that a misalignment groove extending into silicon oxide 14 does not occur.

Accordingly, in the preferred embodiments of the Yamada reference, a misalignment groove is prevented from occurring. **Since a misalignment groove is prevented from occurring in the preferred embodiments, the Yamada reference does not disclose or even remotely suggest using a polymeric product formed during etching of a misalignment groove as an etch stop, as featured in claim 10.**

The Pu et al. reference as also secondarily relied upon by the Examiner is directed to controlling etching selectivity and etch rate microloading. As described beginning in column 1, line 60 of the Pu et al. reference, gas compositions are considered that provide high etching selectivity because dissociated carbon in the etchant gas forms complex polymeric byproducts that deposit as passivating layers on the sidewalls, underlayer and overlayer of the etched features to thereby reduce etching. As particularly described in column 2, lines 5-9 of the Pu et al. reference, although vertical anisotropic etching is desirable, excessive deposition of passivating polymers on the sidewalls of the etched features **is undesirable.** As further described in column 2, lines 28-32 of the Pu et al. reference, it is desirable for the etching process of the preferred embodiments to provide reduced profile microloading and substantially anisotropic etching by controlling the amount of passivating deposits formed on the sidewalls of the etched features. **In other words, an object of the Pu et al. reference is to prevent excessive deposition of passivating polymers that would result in**

stopping of the etching.

In preferred embodiments of the Pu et al. reference, the volumetric flow ratio is selected so that the rate of formation of passivating deposits on etched features of the substrate is approximately equal to the rate of removal of the passivating deposits, as described generally in column 2, lines 51-54. As particularly described in column 6, lines 55-63 of the Pu et al. reference, the nitrogen-containing gas is believed to react with some of the CF_2 radicals to form volatile CN radicals which are exhausted from the process chamber 50. The resultant increase in oxygen species in the plasma zone reacts with free carbon **to reduce the amount of passivating deposits 46** formed on substrate 25, reduce etch rate microloading, and "**prevent** deposition of excessively thick passivating deposit layers **that can stop the etching process**".

Accordingly, the Pu et al. reference is directed to controlling volumetric flow ratios of etching gas **so that excessive passivating deposits are not formed to stop etching.** Since the Pu et al. reference is directed to controlling processing so that etching can proceed without excessive formation of passivating products, the Pu et al. reference would provide no motivation to create the necessary polymeric products to intentionally stop etching. Applicant respectively submits that one of ordinary skill therefore would not be motivated to modify the corresponding processes of the previous relied upon prior art in view of the Pu et al. reference to use polymeric products formed during etching as an etch stop of a misalignment groove. That is, the Pu et al. reference is concerned with controlling formation of passivating deposits so as

to improve etching selectivity and etch rate microloading, not to stop etching of a misalignment groove.

Particularly, the relied upon prior art taken as a whole does not disclose or remotely suggest intentionally using polymeric products formed during etching of a misalignment groove as an etch stop. Since the Pu et al. reference does not use polymeric products to stop etching, the Examiner has clearly relied upon impermissible hindsight to suggest that doing so in the previously relied upon prior art would have been obvious. This should be evident because formation of misalignment grooves is not described or even remotely considered in the Tahara et al. reference, and because the Yamada reference discloses processing that prevents formation of misalignment grooves (rather than stopping further etching thereof). Accordingly, Applicant respectfully submits that the method of forming a conductive path of claim 10 would not have been obvious in view of the prior art as relied upon by the Examiner taken singularly or together, and that this rejection of claims 10-15 is improper for at least these reasons.

Conclusion

The Examiner is respectfully requested to reconsider and withdraw the corresponding rejections, and to pass the claims of the present application to issue, for at least the above reasons.

In the event that there are any outstanding matters remaining in the present

application, please contact Andrew J. Telesz, Jr. (Reg. No. 33,581) at (703) 715-0870 in the Washington, D.C. area, to discuss these matters.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-0238 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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